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Issued February 26, 1915.

GUAM AGRICULTURAL EXPERIMENT STATION,

A. C. HARTENBOWER, Agronomist in Charge.

REPORT OF THE GUAM AGRICULTURAL EXPERIMENT STATION.

1914.

UNDER THE SUPERVISION OF
OFFICE OF EXPERIMENT STATIONS,
U. S. DEPARTMENT OF AGRICULTURE.

WASHINGTON:
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GUAM AGRICULTURAL EXPERIMENT STATION, ISLAND OF GUAM.

[Under the supervision of A. C. TRUE, Director of the Office of Experiment Stations, United States Department of Agriculture.]

WALTER H. EVANS, *Chief of Division of Insular Stations, Office of Experiment Stations.*

STATION STAFF.

A. C. HARTENBOWER,¹ *Agronomist in Charge.*

L. B. BARBER, *Veterinarian and Animal Husbandman.*

PETER NELSON, *Assistant.*

¹ Appointed July 1, 1914, to succeed John B. Thompson, resigned.

LETTER OF TRANSMITTAL.

GUAM AGRICULTURAL EXPERIMENT STATION,
Island of Guam, June 30, 1914.

SIR: I have the honor to transmit herewith a report of the Guam Agricultural Experiment Station, 1914.

Very respectfully,

J. B. THOMPSON,
Special Agent in Charge.

Dr. A. C. TRUE,
*Director Office of Experiment Stations,
U. S. Department of Agriculture, Washington, D. C.*

Publication recommended.

A. C. TRUE, *Director.*

Publication authorized.

D. F. HOUSTON, *Secretary of Agriculture.*

CONTENTS.

	Page.
Report of the special agent in charge.....	7
Introduction.....	7
Personnel.....	8
Office and library work.....	8
Vegetable growing.....	9
Cucumbers.....	9
Okra.....	9
Eggplants.....	9
Peppers..	10
Lettuce.....	10
Radishes.....	10
Carrots.....	11
Beans	11
Tomatoes.....	12
Mango propagation.....	13
Forage crop studies.....	15
Para grass.....	15
<i>Paspalum dilatatum</i>	15
Guinea grass.....	15
Sorghum.....	15
Peanuts.....	16
Apiary work.....	16
Temperature records.....	17
Report of the animal husbandman.....	18
Introduction.....	18
Horse breeding.....	18
Cattle breeding.....	22
Hog breeding.....	25
Goat breeding.....	26
Chicken raising.....	27

ILLUSTRATIONS.

PLATES.

	Page.
PLATE I. Fig. 1.—White Paris Cos lettuce. Fig. 2.—Pencil Pod wax beans. Fig. 3.— <i>Paspalum dilatatum</i> five months after planting.....	16
II. Fig. 1.—Inarched mango tree bearing at less than one year. Fig. 2.— Transplanted mango tree. Fig. 3.—Transplanted mango tree after eight months.....	16
III. Fig. 1.—Yearling filly by Cassius, with dam. Fig. 2.—Half-blood Ayrshire bull, 18 months old, weight 700 pounds. Fig. 3.—Half- blood Ayrshire heifer, 21 months old, weight 600 pounds.....	24
IV. Fig. 1.—Imported doe, Japanese milch goat. Fig. 2.—Crossbred buck, Japanese-native stock.....	24
V. Fig. 1.—Crossbred doe, Japanese-native. Fig. 2.—Pure-bred doe, native	24

TEXT FIGURES.

FIG. 1. Temperatures at Guam Station, July to December, 1913.....	19
2. Temperatures at Guam Station, January to June, 1914.....	20
3. Temperature chart of John Gray.....	23
4. Temperature chart of Willowmoor Red Rose	24
5. Temperature chart of Willowmoor Queen Bess.....	24
6. Temperature chart of Netherhall King B.....	25

REPORT OF THE GUAM AGRICULTURAL EXPERIMENT STATION, 1914.

REPORT OF THE SPECIAL AGENT IN CHARGE.

By J. B. THOMPSON.

INTRODUCTION.

The station work as outlined in previous reports has been continued along the same general lines during the past fiscal year. Climatic conditions prevailing throughout the year, a typhoon on November 5 and 6 and another of less intensity in June not considered, have been unusually favorable to general agriculture as well as to a majority of the field operations in progress at the station. Rainfall has been more equally distributed throughout the period in which drought generally obtains, with the dry season less distinct and less prolonged than usual. The routine work connected with the station continues to increase. Considerable improvement has been made during the year. The construction of an addition to the station barn measuring 30 feet in width and the same in length, and providing six good box stalls, is included in this work. The growth in library and office work and the appointment in September of a veterinarian and animal husbandman combined to render the original office space inadequate, and an addition to the office building providing room for this increased amount of work was constructed during the year. The breeding of live stock is showing successful results, and as this work progresses it continues to become more and more interesting. The results of mating a pen of single-comb Brown Leghorn hens with a native black-fleshed cock has been of special interest to the writer. Out of 18 pullets of this cross nine had dark-green legs and black flesh, resembling in these features the male parent, and the remaining nine had dark-green legs resembling the male parent with white skin and flesh of a normal color resembling more closely that of the Brown Leghorn than that of the native black-fleshed parent. From 23 cockerels out of the same breeding pen all had white skin and flesh resembling that of the Brown Leghorn, 20 had white legs, one had one white leg and one of a dark-greenish hue, and the remaining two resembled each other in having one white leg with a black patch on the other leg. In this work a strong tendency is shown for

the color characteristics to be transmitted by the parents to the progeny of the opposite sex.

The need of land for the gradual growth and expansion of the station work has been met during the year by the purchase of a tract of land lying in the district known as "Cotot." The Cotot River, an ever-flowing stream of crystal-clear water, crosses this property and furnishes an abundance of good clean water for domestic animals. The tract which will be utilized as a stock farm upon which a large portion of the breeding work will be conducted in the future comprises an area of about 1,200 acres, much of which is rough in character. The purchase price of this land to the Government was \$2,000.

PERSONNEL.

On September 27, 1913, Dr. L. B. Barber arrived in Guam and immediately entered upon his duties as veterinarian and animal husbandman, his appointment to this position having become effective on September 1. Mr. A. C. Hartenbower reached Guam on June 29 to relieve the writer as special agent in charge of the station, and the transfer of responsibility was effected on June 30, the close of the fiscal year covered by this report.

OFFICE AND LIBRARY WORK.

Mr. P. Nelson has had charge of the library and office work of the station for the past four years. The system of filing records, correspondence, etc., adopted by him upon assuming charge of this work has been consistently adhered to, and as a result of this fixed system all records are conveniently accessible. Mr. Nelson's duties extend beyond the office, and a very large portion of his time has been employed in directing and assisting in the construction of buildings, installing machinery and operating the same, and in view of the general nature of his work, the strict attention given to the most minute details of the office work is deserving of special credit. At the close of the year the station library consisted of about 1,500 bound volumes and approximately 5,000 bulletins, reports, etc., in loose-leaf binders, besides a large number of similar publications in cabinet binding cases and in separate files. The office building is light and airy, and only in extremely wet periods does mildew, which is an almost constant cause of grievance in the common, poorly lighted, poorly ventilated, moisture-laden buildings constructed with thick masonry walls, affect to any extent the books in the station library, and even at these times the damage done is not serious. The library is equipped with sectional book-cases made from quarter-sawed oak and fitted with plain glass doors. In Guam this system is decidedly superior to open shelving which admits wasps to soil the volumes and cockroaches to destroy their

bindings. Sectional furniture is also advantageous, as new units may be purchased to provide additional shelving space as the growth of the library demands.

VEGETABLE GROWING.

The growing of vegetables, partially in an experimental way, and partially to demonstrate methods of production, has been in progress since the station was first established. In this work considerable data have been obtained relative to the production of many of the common vegetables in Guam.

CUCUMBERS.

Vigorous and heavy yields are obtained from plantings made from November to March, provided a suitable location is selected and proper cultural methods are followed. During the period of intense heat from April to July the crop is less successful. On exceptionally well-drained soil, which unfortunately is not available at the station, good results may be had from plantings made during a greater part of the wet season. At this station the cucumber has produced as much as 83 dozen good marketable cucumbers on 80 feet of row. A species of aphid frequently attacks the leaves of the cucumber and causes much damage when effectual protective methods are not promptly taken. The simplest effective measure for controlling this pest where plantings are made in close proximity to a line of pipe carrying a sufficient amount of pressure is found in training a stream of water upon the plants through a common garden hose fitted with a nozzle constructed for throwing a solid stream.

OKRA.

This vegetable is of unusually vigorous growth and is correspondingly productive in Guam. The variety commonly cultivated in the United States under the name White Velvet has been grown on the heavy clay soil of the station, and when given plenty of space has attained a height of from 7 to 8 feet. It is grown at the station throughout the entire dry season without difficulty and is easy of cultivation. The plants are attacked by an aphid which is best controlled by the system suggested above for cleaning cucumber vines from a similar or possibly identical pest. A lepidopterous larva has occasionally been observed to bore in the young seed pods, but in the work with okra the occurrence of this latter pest has been rare.

EGGPLANTS.

This crop is easily grown in Guam and produces heavy yields of an excellent quality. It has been grown at the station throughout

the dry season from November to July, and on well-drained soil may be produced throughout the entire year. At the time this station was established two varieties of the eggplant, one a small round-fruited sort and the other a long-fruited type, both of inferior quality, were grown on the island. The station introduced seed and grew the variety known as the New York Improved Spineless. This variety proved so eminently satisfactory that it has been steadfastly adhered to, and seed has been given out in distribution until among the eggplants now in cultivation this variety predominates. The plants are frequently attacked by aphids. A mealy bug also feeds upon the plants occasionally, but this pest is rarely troublesome. A red biting ant is sometimes found upon the plants in large numbers when aphids are present and makes itself unpleasant to persons working about the plants. These ants are attracted by honeydew secreted by the aphids and cause no direct damage to the crop. With the aphids properly controlled they cause no trouble.

PEPPERS.

The natives of Guam are extremely partial to the pepper, and this vegetable thrives in all its forms, from the small native chili pepper with its strongly pungent flavor to the large mild introduced varieties. The Large Bell or Bull-Nose pepper is the variety most commonly planted at the station. This variety, however, is of a hot, pungent flavor when grown during the dry season, though it is decidedly mild and sweet when grown during the season of wet, cloudy weather. During the past fiscal year an experiment to determine the influence of shade upon the flavor of the fruit has been in progress, and preliminary results indicate that under partial shade this pungency is greatly reduced. The experiment was conducted during the hot, dry season. The pepper has no serious pests in Guam and is produced with the greatest ease.

LETTUCE.

Climatic conditions in Guam are well suited to the cultivation of lettuce. A comparatively large number of varieties of the ordinary type have been tested at the station, and all have given good results during the cool season from November to March. This period is usually followed by a season of hot, dry weather and constant sunshine, when varieties of the Cos strain are most successful. (Pl. I, fig. 1.) Lettuce has no insect enemies in Guam, and the only disease that has been observed is a sort of root rot that has not caused any very serious damage.

RADISHES.

This vegetable is grown without difficulty as far as climatic conditions are concerned, but the results are rendered uncertain owing to

the frequent attacks of a lepidopterous larva, *Hellula undalis*, which acts as a defoliator and sometimes enters the root at the crown. This pest does not seem to appear at regular intervals or at certain set or determinable seasons. It may attack and entirely destroy the crop, or it may be entirely absent. Usually a crop planted at any time from November to February, the season during which the radish succeeds best, will escape the ravages of this pest, though this is by no means certain. Spraying with a poisonous spray is beneficial. Lead arsenate has been employed at the station with fair results. The native gardener, however, has not reached that stage of modern progress in which he might be induced to practice such methods of insect extermination. An aphid sometimes causes some damage to the crop, but this pest is less destructive than the caterpillar mentioned above and may be easily controlled. It is dislodged from the leaves without difficulty by a stream of water directed upon the plants under sufficient pressure, through an ordinary garden-hose nozzle, where the necessary facilities are available. Variety tests in which both early and late sorts were represented have been conducted at various times within the past five years, and the results have always been in favor of a large white Chinese variety, seeds of which are obtained through Chinese merchants in Manila. This variety is not only more productive than other kinds but has also the advantage of remaining crisp and tender for a much longer period of time.

CARROTS.

The cultivation of carrots has been practiced with success at this station during the past five years. The plantings have been limited exclusively to the dry season extending from November to July, and only in very exceptional seasons have we failed to secure at least fair results where irrigation water was obtainable. The extreme heavy clay character of the soil of the station grounds, its retentive nature, and the impossibility of practicing proper methods of soil preparation and cultivation during the period of heavy rains have prevented the trial of this vegetable during that season. In Guam the carrot is free from insect enemies.

BEANS.

Beans planted during the period from November to March and properly managed produce remarkably heavy yields in Guam with a minimum of attention. Variety tests of string beans have resulted in favor of the variety known as Pencil Pod Black Wax as against some ten or more other sorts with which it has been grown in comparative test. (Pl. I, fig. 2.) Less success generally follows when plantings are made during the hot, dry season from April to July. Lima beans have also yielded most satisfactory crops, the variety known as Hen-

derson Bush being eminently superior to all others tested. This Lima bean has produced as many as three good crops from a single planting. The larva of a small moth sometimes destroys the crop by feeding upon the bean within the pod, beginning its work of devastation as the crop approaches maturity. A small pink or reddish-colored leaf miner feeds within the tissues of the leaves of both string beans and Limas. This insect causes the appearance of white, shining patches upon the leaves, robbing them of their beauty but apparently having little influence upon production.

TOMATOES.

For the past five years special attention has been given the problem of developing a strain of the tomato that might be successfully grown under the peculiar climatic conditions, but until the year that has just closed all efforts have entirely failed. During the early part of the fiscal year that has just ended, in a letter from Reasoner Brothers, Oneco, Fla., a suggestion was made to test seed of the Texas Bell tomato, an improved form of the small cherry variety being exploited by Ramsey & Son, of Austin, Tex. Acting upon this suggestion an order was placed for a quantity of seed, and this arrived on October 28. A portion of this lot was distributed to intelligent farmers for experimental planting, and the remainder was sown in seed flats on October 31 to furnish plants for trial at this station. When these plants had attained sufficient size, they were potted to 3-inch pots, and on December 10, 306 plants were set permanently in the field. Of this number only about 200 lived and produced a crop of tomatoes. The fruits from a large portion of these vines were very small, but they were mild and savory and entirely devoid of the sharp acid flavor of the small native tomato. The chief virtue of this tomato in Guam is its prolific fruiting habits which, it must be admitted, would not appeal favorably to the tomato grower of the United States, though a fixed variety equally productive will certainly command a deep respect in Guam, where failures have consistently followed every effort to grow this vegetable. Individual plants grown in this experiment showed a wide variation in the size of fruits produced, and some 12 or 15 plants carried fruits having an average weight from four to five times as great as the average weight of those borne on plants producing fruits of the smallest size. Tomatoes grown on a selected vine measured approximately 2 inches in diameter, and nine of these weighed 1 pound. From another vine the fruits averaged about 1 inch in diameter, and 42 of these were required to constitute a pound of weight. To those who are unfamiliar with conditions in Guam the desirability of a fixed type of tomatoes equal even to the largest of the types described above may not be plain, and the simplest explanation

possible can be made through the citation of a concrete example. A small quantity of seed of the Texas Bell tomato was given to Mr. Freegord, who operates a small ranch on Orote Peninsula. This gentleman reports that a portion of this seed was planted, and from 64 hills he actually picked and weighed 170 pounds of tomatoes, for which he received 10 cents per pound. Aside from these sales this planting also furnished tomatoes for his home table throughout the entire season, besides some 35 or 40 pounds which were used in the preparation of Spanish sauce. This gives some idea of the yield that may be expected from this variety when grown under ordinary farm conditions, and also of the local demand for the product. The remarkable type variation shown among the individual plants suggests a promising field for variety improvement, it being assumed that seed obtained from selected plants would, if cross fertilization were prevented, reproduce a desirable type. An experiment previously conducted indicated the practicability of growing tomatoes from cuttings set directly in the field, and advantage was taken of this method of propagation to obtain a number of plants from a selected individual. On May 4 cuttings about 18 inches long were taken from a plant yielding a heavy crop of uniformly large and well-formed fruits and set in a garden bed, being planted to a depth of about 12 inches and at intervals of about 42 inches in either direction. A temporary shade was erected over these cuttings, and an abundance of water supplied until all plants were well rooted. A survey was then made of the immediate vicinity, and all plants growing within a radius of several hundred feet were destroyed to prevent cross-pollination. It was observed that the honeybees from the station apiary did not frequent the flowers of the tomato, hence no grave dangers of these plants mixing with others from a considerable distance were anticipated. At the close of the past fiscal year these plants carried a fair crop of partially developed tomatoes, which it is hoped will furnish sufficient seed for further selection work during the coming season. As the crop from this planting will mature during the wet season, when the best results from the tomato can not be expected and when the dangers of failure are greatest, seed has been selected from another desirable plant which produced unusually large fruits and from which 219 tomatoes in various stages of development were gathered at one time. This plant was grown in the field with others, where cross-pollination is naturally anticipated.

MANGO PROPAGATION.

The propagation of the mango has been continued, and a limited number of inarched plants resulting from this work have been distributed to planters during the year. As a further evidence of the

early bearing habits of the superior local variety when inarched, small trees propagated and which flowered during the same period have again borne flowers during the past year. The accompanying illustration shows an inarched plant measuring 18 inches in height, carrying a mature fruit within less than one year from the time the process of inarching was begun. (Pl. II, fig. 1.)

An interesting demonstration of the possibilities of transplanting large mango trees was made possible by the typhoon which visited the island on November 10. A tree measuring 33 inches in circumference at 3 feet above the ground was torn out by the roots during the force of this storm, the taproot over 4 inches in diameter being broken off about 18 inches below the surface of the ground. After the typhoon had subsided the top of this tree was severely pruned back, all branches under 2 inches in diameter being removed and larger ones severed at points where they had diminished to $1\frac{1}{2}$ to 2 inches in diameter. All wounded surfaces were immediately treated to an application of grafting wax. The tree was then dug out and the taproot severed just above the break. In this trimmed condition the weight of the tree was such as to tax the full strength of seven men in sliding it onto a truck and was estimated at from 1,200 to 1,500 pounds. It was transferred a distance of about 80 rods from the spot where it originally grew and reset on the lawn facing the office. To reduce the dangers from drying winds the trunk and limbs were protected by tying about them a layer of cornstalks and other refuse. (Pl. II, fig. 2.) This protective material, as well as the soil about the tree, was watered frequently, and new growth began to show itself in about two months after transplanting. The tree has made good growth throughout the dry season and is now considered well out of danger, as the approaching wet season should furnish favorable conditions for a period of time sufficient to insure its ultimate success. (Pl. II, fig. 3.) One weakness, however, which will not probably be overcome for some years, is the loss of the taproot with the consequent loss of power to withstand the force of severe winds, although deep planting was resorted to as a partial protection against this danger. The conditions under which this tree was transplanted were unfavorable, the roots being severely twisted and broken, as the tree was literally torn from the ground. A condition of much greater importance was the approaching dry season, the least favorable season of the entire year for transplanting. The success of this tree under adverse conditions leads to the belief that mango trees of any size may be transplanted with safety under favorable conditions, where adequate facilities for handling and transportation are provided.

FORAGE-CROP STUDIES.**PARA GRASS.**

Para grass has been grown at the station for the past four years, and it furnishes the bulk of forage required by all stabled animals. It is managed largely as a soiling crop, but during the past year it has also been utilized satisfactorily as a pasture grass. No other cultivated forage crop at the station has been eaten with the same persistence and regularity in all stages of maturity as has been this grass. As a pasture grass this species will not stand trampling or severe drought equal to *Paspalum*.

PASPALUM DILATATUM.

The acreage devoted to *Paspalum* at the station has been increased during the past year. Observations on its behavior at the station during the last season indicate a much wider field of usefulness for it than had previously been recognized. A considerable acreage of the hill lands of the island now seems to be suited to its growth, and in this event the possibilities which this crop offers to the stockman will be very greatly increased. Land on comparatively high elevations has been cleared and prepared for planting during the approaching wet season. It is also planned to plant this crop more or less extensively on the new tract of land which was purchased for use as a stock farm during the past year. (Pl. I, fig. 3.)

GUINEA GRASS.

On heavy clay soil Guinea grass has not given the same satisfactory results as a soiling crop as has Para grass, nor has it proved equal to *Paspalum* as a pasture grass. On more suitable soil, however, this grass will produce remarkable yields of a succulent green soiling feed in this climate, and a supply of roots has been kept available for trial on the new Cotot stock farm when operations are begun there. The small planting at the station has been utilized as a pasture crop during the past year. It is ravenously eaten by stock, and as a change of feed where variety in the ration is not easily provided, a small planting, even on this soil, where growth is rather indifferent, is quite desirable.

SORGHUM.

A 1-acre plat of Early Amber sorghum was grown at the station during the past year, and this has furnished an abundance of green feed for hogs and considerable grain for chicken feed. Sorghums of both the saccharin and nonsaccharin varieties succeed well in Guam, and during the dry season they yield heavy crops of grain, those of

the latter class being best adapted for feed. The sorghum midge, which renders the grain-sorghum industry uncertain and unprofitable in many sections of the Southern States, is not found in Guam.

PEANUTS.

A plat with an area of almost an acre was planted to Spanish peanuts during the last week in January of the current calendar year. The seed nuts were soaked in water for a period of about 12 hours immediately prior to planting, and these were dropped in rows 30 inches apart, with the nuts 15 inches distant in the row. The bulk of this planting was accomplished on Saturday, January 31, but a small quantity of seed nuts which still remained when work was suspended on that evening was scattered on a cement floor in a wet condition and had begun to sprout when planting was again resumed, two days later. Observations were taken on the growth of nuts from these different plantings, and from the planting made January 31, from seed soaked for 12 hours, the germination was estimated at 65 per cent, while that concluded on February 12, from seed remaining in a moist condition in the shade for 36 hours in addition to the treatment given the previous lot, showed an estimated germination of 85 per cent. All these peanuts were planted in the unbroken shell. A portion of the product of this planting was fed before reaching maturity, but a measured area was allowed to ripen and was harvested and weighed on May 29, the undried vines yielding at the rate of 6,750 pounds and the nuts 700 pounds per acre. These yields are, however, considerably below the average yield previously obtained from this crop. The success of the peanut as a forage plant in Guam is very much to be desired, as there is a serious want of a good nitrogenous feed that can be produced on the island, and at present this crop offers the greatest promise of filling this want.

APIARY WORK.

Some gratifying results of the work on the honeybee in progress at this station are becoming manifest in a broader local interest in the application of modern methods of honey production. For the past two years this station has maintained for demonstrational purposes a small apiary, which has not at any time exceeded 32 colonies in size. The object of this work is largely to encourage the handling of bees for providing a supply of honey for home use. The station is provided with modern equipment sufficient for handling bees on a small scale, and the use of this equipment with up-to-date methods employed in the various branches of beekeeping have been demonstrated and explained to all parties manifesting an interest in the work. At the time this station received its first modern movable-frame hives there was not a single hive on the island other than the ordinary box



FIG. 1.—WHITE PARIS COS LETTUCE.



FIG. 2.—PENCIL POD WAX BEANS.



FIG. 3.—PASPALUM DILATATUM FIVE MONTHS AFTER PLANTING.



FIG. 1.—INARCHED MANGO TREE BEARING
AT LESS THAN ONE YEAR.



FIG. 2.—TRANSPLANTED MANGO TREE.



FIG. 3.—TRANSPLANTED MANGO TREE AFTER EIGHT MONTHS.

hive; and in Guam these hives consist of unconverted beer cases, soap and cracker boxes, or of boxes of a wide range of forms and sizes which are originally received as containers of merchandise. It is scarcely necessary to say that under such a system of management the bee industry could never attain a well-developed and thriving condition. Since the inauguration of the apiary work at this station not less than 12 interested parties have obtained for their own use improved movable-frame hives and are now handling bees on a more or less extensive scale under greatly improved conditions. A great majority of this number, however, are residents of European descent. The average native of Guam is extremely hesitant in the investment of a dollar in a new enterprise or in farm equipment that has not, through custom or long usage, become an acknowledged necessity. It is hoped that through the work of the station and of those who are adopting the better methods many of the more intelligent class may be convinced of the advantages of up-to-date practices and modern equipment. The present governor of Guam, Capt. W. J. Maxwell, United States Navy, who is deeply interested in any industry that tends to render the island more nearly self-supporting, has added a course in practical beekeeping to the work of the common schools, and this training of the younger generation should, in the course of time, exert a wide influence over the methods of beekeeping. Among those who have taken up the work, Mr. P. Nelson, of this station, seems to have made the most rapid progress, having at the close of the year for which this report is rendered a thriving little apiary of nearly 50 colonies. All of these colonies are in Langstroth movable-frame hives, and his equipment includes a honey extractor and all the supplies required for the production of extracted honey along up-to-date lines. With an area of only 210 square miles, Guam offers but limited possibilities for the development of the bee industry. Within its limits, however, the opportunities are promising, and this is especially true of the forest-covered areas of the north, and to a less extent in scattered localities throughout the island. The consumption of honey on the island should be largely increased, and any demand created for honey for food purposes among the present population could readily be supplied, leaving still a considerable quantity of both honey and wax for export if the industry were developed to the full extent of its possibilities.

TEMPERATURE RECORDS.

Maximum and minimum temperatures at the Guam station have been recorded during the past year, and in the following table a comparison of these temperatures by months and those of the preceding fiscal year similarly arranged is shown.

Comparison of monthly maximum and minimum temperatures for the fiscal years 1913 and 1914.

Month.	Maximum.		Minimum.		Month.	Maximum.		Minimum.	
	1913	1914	1913	1914		1913	1914	1913	1914
July.....	95	96	73	74	February.....	88	87	68	68
August.....	93	93	73	70	March.....	90	90	68	72
September.....	93	93	72	72	April.....	93	95	70	70
October.....	91	90	73	72	May.....	95	96	72	73
November.....	88	88	72	72	June.....	95	96	73	73
December.....	87	87	73	68	Year.....	95	96	68	68
January.....	88	88	70	72					

These temperatures were taken from the northeast corner of the office building where the thermometer was protected from the sun by the veranda roof. It will be noted that the absolute range between the coolest night and the warmest day temperatures for the entire period of two years was only 28° F. Charts showing the daily maximum and minimum temperatures for the year ending June 30, 1914, are shown in figures 1 and 2.

REPORT OF THE ANIMAL HUSBANDMAN.

By L. B. BARBER.

INTRODUCTION.

The work in animal breeding which has been conducted under a definite project since the first half of the fiscal year 1912, has shown most gratifying results, and as one of the most important lines of work in progress in this department it presents a wide field for work which is both promising and attractive. While the station has suffered the loss of several imported animals since the breeding work was first inaugurated, the general superiority of the progeny from native dams by the imported sires and the apparent hardiness and constitutional vigor of these crosses render the present status of the work very encouraging.

Bacteriological work has necessarily occupied a place of minor importance during the year due to the limited laboratory equipment. For the present only the most important problems of this phase of the work can be considered. It might be said, however, that the live-stock interests of Guam are fortunate in the remarkably small list of serious diseases which exist among the animals of the island.

HORSE BREEDING.

The horse-breeding records for the year credit the brown stallion Donald with two foals. These are both out of native mares and show marked improvement over the pure native animal from the viewpoints either of size or of conformation. They inherit size and

quality from their superior sire, while they seem to retain in a full measure the hardiness and vitality of their native dams. One of

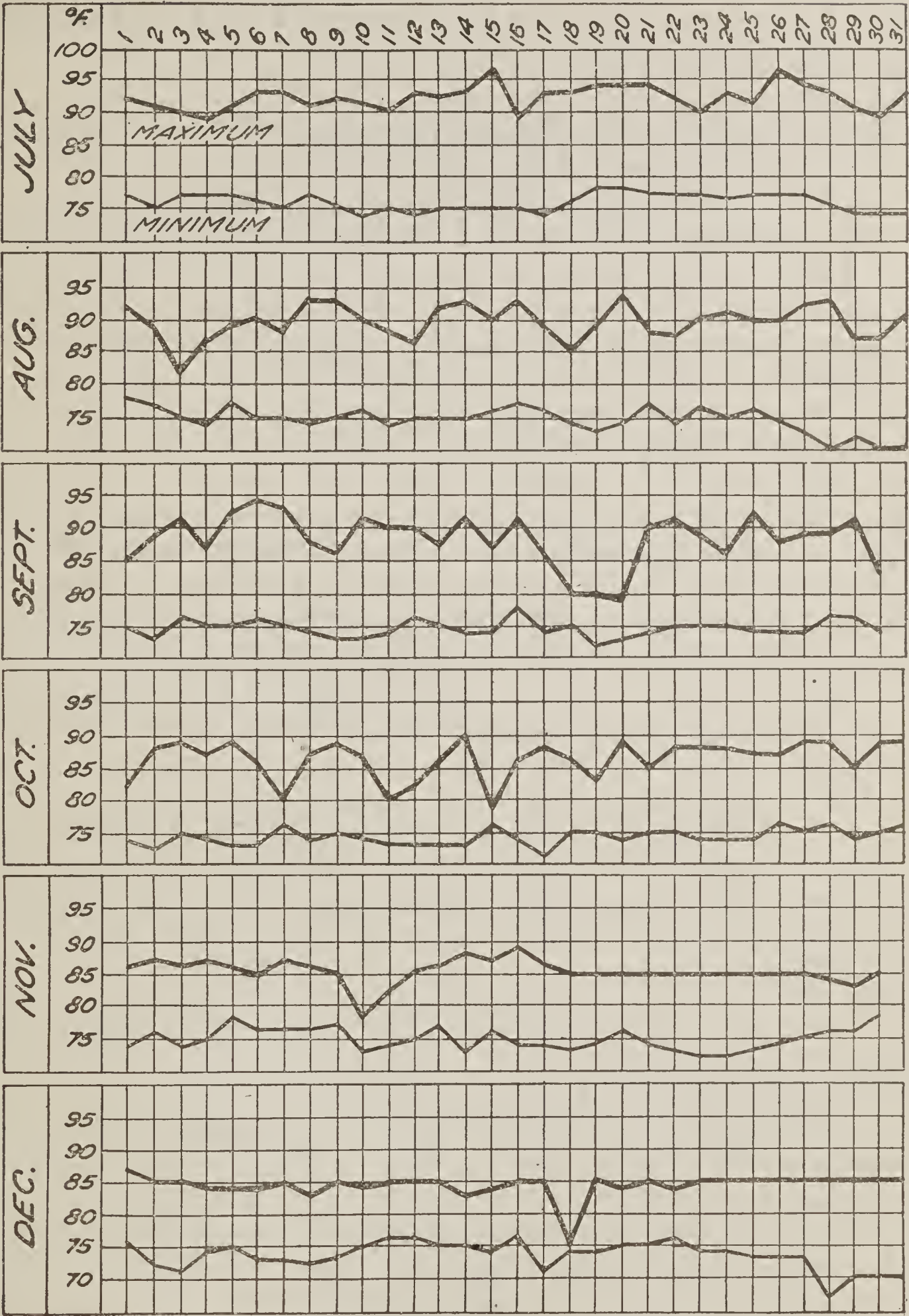


FIG. 1.—Temperatures at Guam Station, July to December, 1913.

these foals weighed 80 pounds at birth, the mare weighing at the same time 502 pounds. Six mares have been bred to the stallion Donald during the year.

The three registered Morgan mares owned by the station have all been bred to Cassius, the older stallion. Princess Angeline, dam of

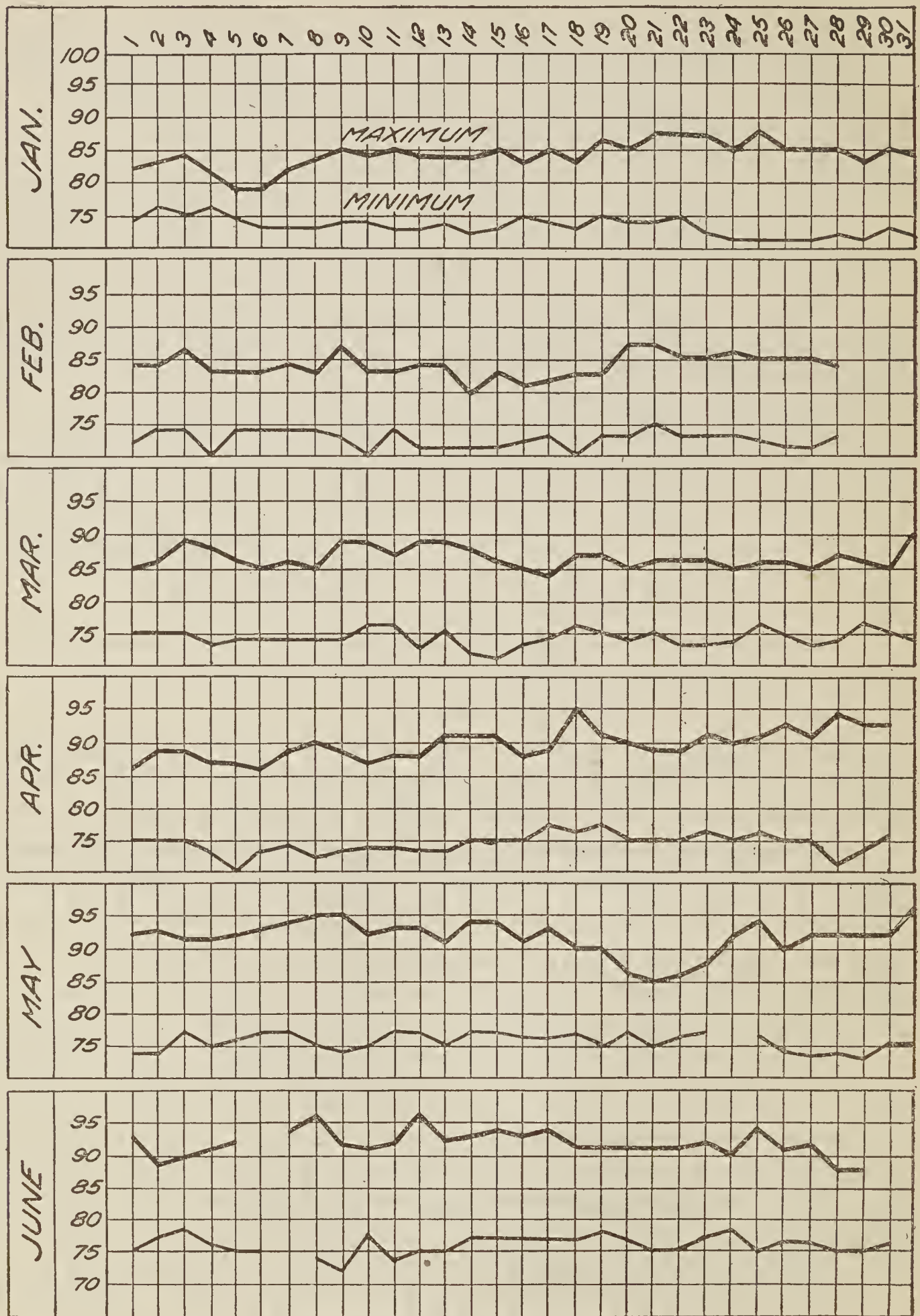


FIG. 2.—Temperatures at Guam Station, January to June, 1914.

the filly Mariana Bell, foaled during the preceding year, again shows distinct indications of an advanced condition of pregnancy. On November 18 of the past year the young mare Mayport aborted

a female fetus showing about two months' development. The mare was rebred on December 22 following, and has manifested no indications of a heat period since that time. The bay mare, Kit of Willowmoor, failed to become pregnant until a few weeks immediately preceding the close of the year, though various treatments were employed to that end. The mare has been repeatedly bred and rebred to the two stallions alternately during the past two years, and artificial impregnation has also been practiced at different times within the same period. At the close of the year to which this report applies several weeks had elapsed in which this animal had shown no indications of heat, and some hope that she has at last become pregnant may now be entertained. Five mares exclusive of those belonging to the station have been bred to Cassius since the close of the preceding fiscal year. Many of the owners of native mares have shown a reluctance to breed to the Morgan stallion, due to a fear that the lives of the mares might be endangered at parturition through the large size of the foal. The fallacy of this theory has been fully proved by the easy and natural deliveries of several foals, and as the crossbred animal possesses undeniable superiority over those of purely native blood, a steady increase in the usefulness of these animals may be anticipated (Pl. III, fig. 1). An executive general order promulgated by ex-Governor Salisbury some two years ago placed an annual tax of \$5 United States currency upon stallions, the object of this measure being to encourage the castration of undesirable animals. As a further encouragement toward ridding the country of such horses as are unfitted for breeding purposes, the writer offers to castrate all such animals if brought to the station, free of charge. Mr. R. C. Gibson, in charge of the Navy corrals at Agana, also castrates animals free of charge upon their presentation at his place of business in Agana. These influences should also work toward an increase of public interest in the Morgan horses and enlarge their service records in the future.

The horses have been more or less infested with the common mawworm, *Oxyris curvula*. This intestinal parasite yields readily to treatment, and it has not been allowed to multiply in numbers to an extent at which it could produce serious results. Among the minor details of stable management the horses' feet are found to become intensely dry. An atrophic condition of the frog occurs, the soles drop, the walls crack, and a generally unfavorable condition prevails. These disorders of the feet are most common during the dry season, and especially during this period constant attention to these parts is necessary. Tetanus is a common disease on the island, and in the treatment of wounds the utmost care is necessary in order to prevent the danger of this infection. The stallions have

shown some tendency toward impotency, but it is believed that in some cases of failure to get foal the fault has been with the mares rather than with the stallions. At the close of the year the horses showed every indication of health and vigor, and it is hoped that the stallions will, under the present system of management, prove more potent and that the number of their get will be correspondingly increased.

CATTLE BREEDING.

Thirty-three cows were bred to the two station bulls during the past year. Twenty of this number were bred to Netherhall King B No. 14591, 16 being bred in Upe, a district in the extreme northern end of the island. Eleven cows were bred to the imported Ayrshire bull John Gray, and two heifers, got by this sire, were bred to Harry Gray, a pure-bred Ayrshire bull bred and raised by this station and 17 months old at the end of the year. The heifers bred to this bull were: Guam Island Rose, a pure-bred Ayrshire animal bred and raised by this station, and Maria Gray, a native-Ayrshire cross purchased by the station as a young calf during the preceding fiscal year. The heifer mentioned last was nearly 21 months old at the close of the fiscal year and weighed over 600 pounds (Pl. III, fig. 3). John Rhodes, a bull of similar breeding, was nearly 18 months old at the end of June and weighed almost 700 pounds. John Rhodes was bred and raised by this station and is, without any doubt, the largest and best animal of his age on the island (Pl. III, fig. 2).

All the imported cattle have again showed themselves subject to attacks of fever at various times during the year. In the case of John Gray these attacks have been of short duration and have only slightly affected his general condition. The Ayrshire bull, Netherhall King B, showed little variation in temperature prior to January 6, his normal temperature until that time being about 102° F. On January 6 the animal was taken to Upe, where there was a comparatively large herd of cows, owned by two breeders who were anxious to breed to the Ayrshire bulls. On January 25 a report of the death of Netherhall King B was brought to the station, and early on the following morning the writer proceeded to the scene of his death for the purpose of examining the carcass and determining, if possible, the cause of death. It was found upon arrival that dogs or other animals had mutilated the carcass and that post-mortem changes had taken place rendering an examination of no avail. On February 26 Queen Bess, an imported Ayrshire cow, showed an abnormally high temperature with other disease symptoms. The intensity of these symptoms increased steadily until the cow succumbed on March 8. The symptoms observed in this case were similar to those noted in a like attack which caused the death of the bull Willowmoor Moonstone on December 19, 1911. The principal clinical symptoms observed in

the case of Queen Bess were extreme emaciation, a depraved appetite, and a more or less intermittent fever. A post-mortem examination of the carcass disclosed lesions indicative of Texas fever. Some of the most important features brought to light by this examination were a greatly distended and hardened condition of the bile ducts and the occlusion of these vessels with a very hard gritty substance, a yellow, flaky, and characteristically stringy condition of the bile, and greatly enlarged and disintegrated spleen. The close of the year left Red Rose, another imported Ayrshire cow, in a weak and debilitated condition, due largely, it is believed, to the effect of these attacks. As a result of one of these periods of fever during April this cow dropped a premature heifer calf, and from that time to the

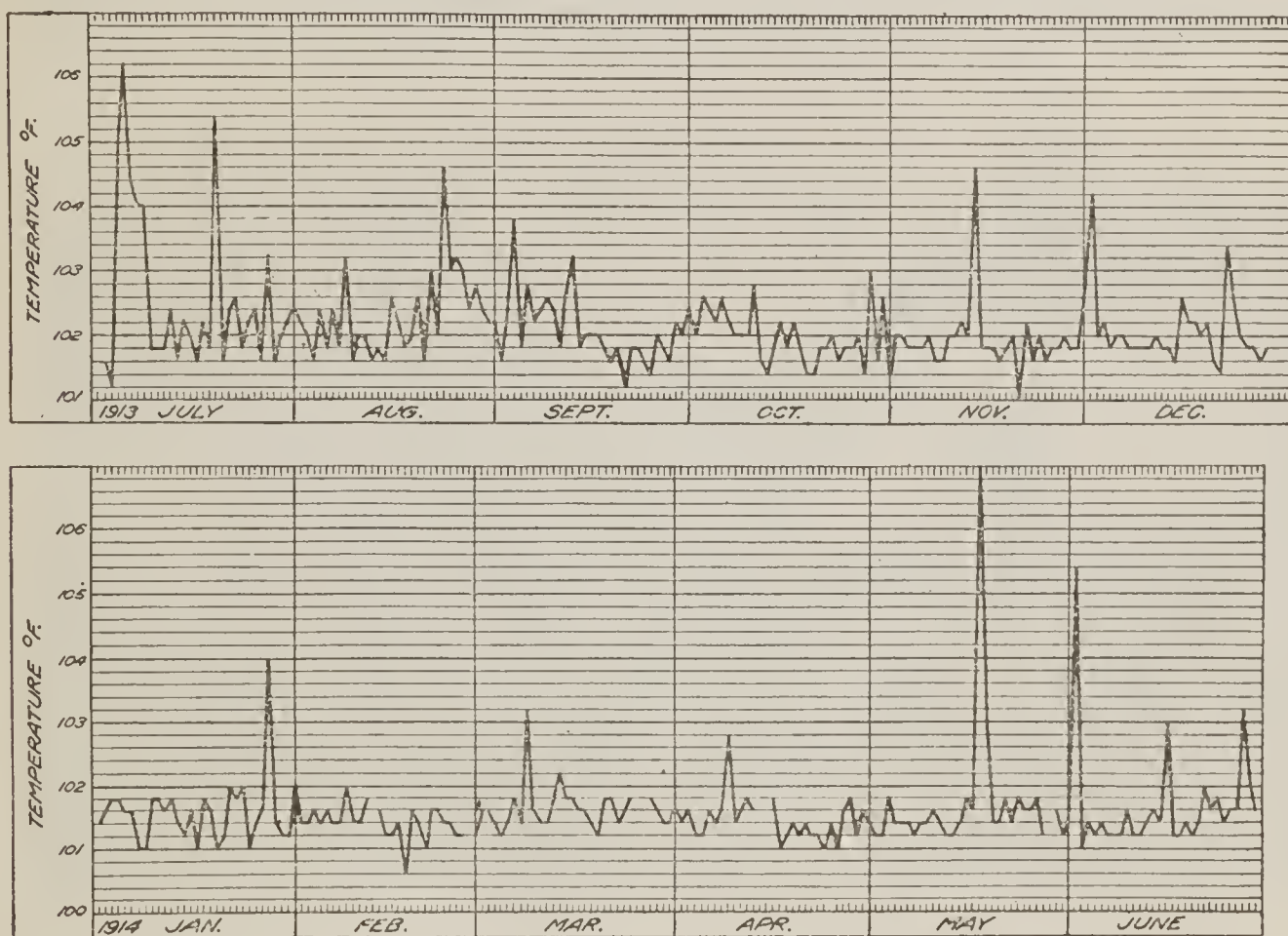


FIG. 3.—Temperature chart of John Gray.

close of the fiscal year she had not regained her normal condition. The immunization of susceptible cattle from the United States by the method of controlling tick infestation has not proved complete or reliable, but results in what appears to be a chronic form of the disease. In the introduction of cattle into Guam the great importance of securing immune stock is plainly recognized. The daily temperature records of the imported stock have been kept, and these aid greatly in the detection of the disease in its incipient form. Temperature charts have been adapted from these records and are submitted with this report (figs. 3 to 6).

Near the close of the year the tuberculin test was applied to 10 of the station animals, none of which showed a reaction. Of this

number six were native animals, one an Ayrshire-native cross, and the remaining three were pure-bred Ayrshires. The test of a com-

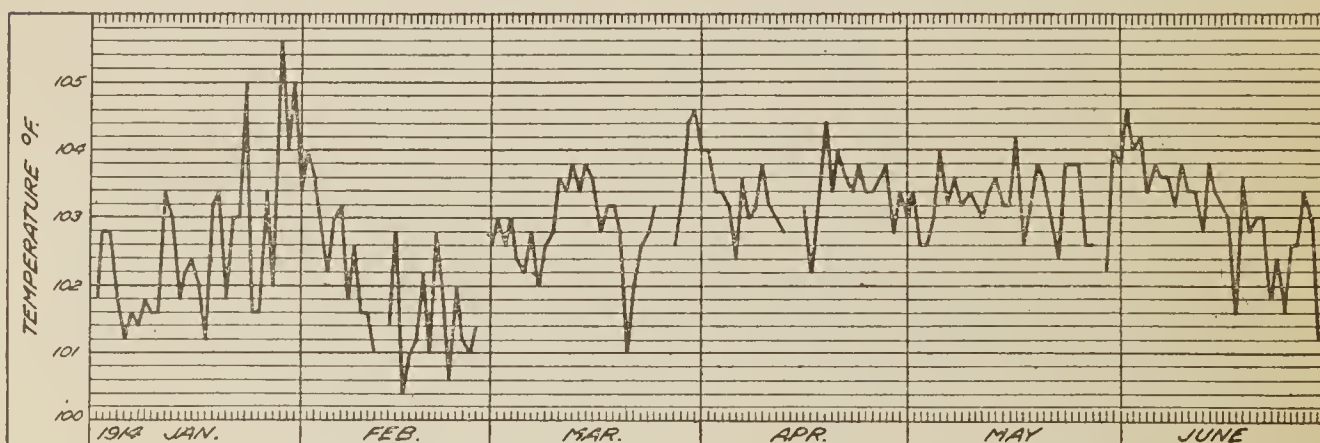
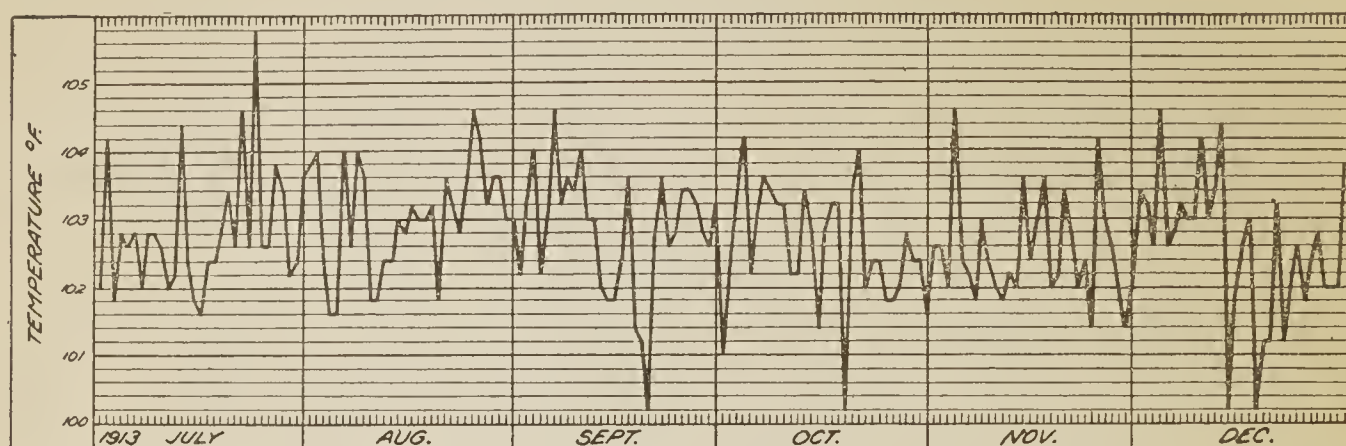


FIG. 4.—Temperature chart of Willowmoor Red Rose.

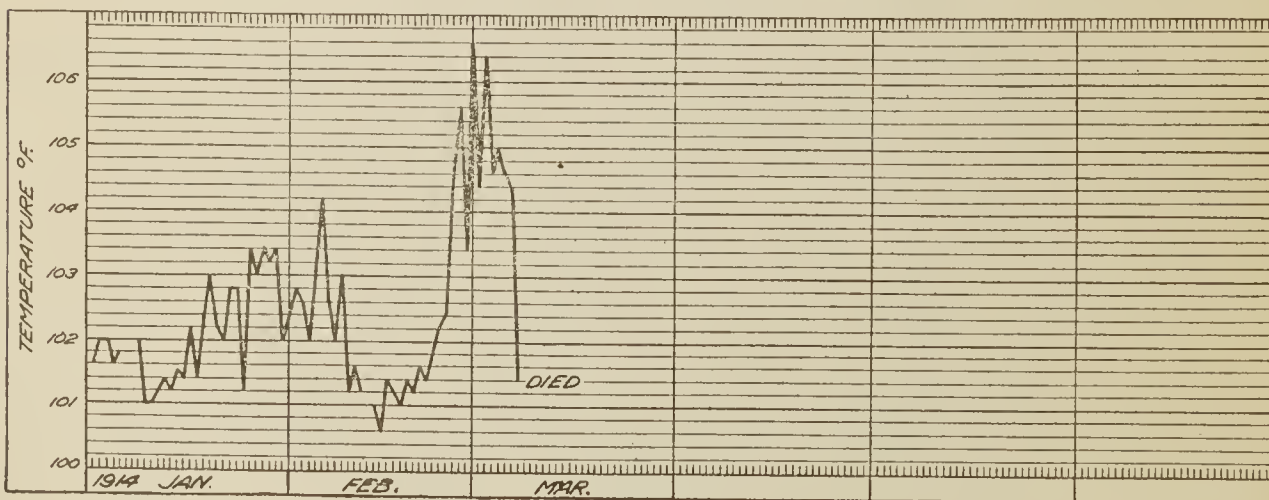
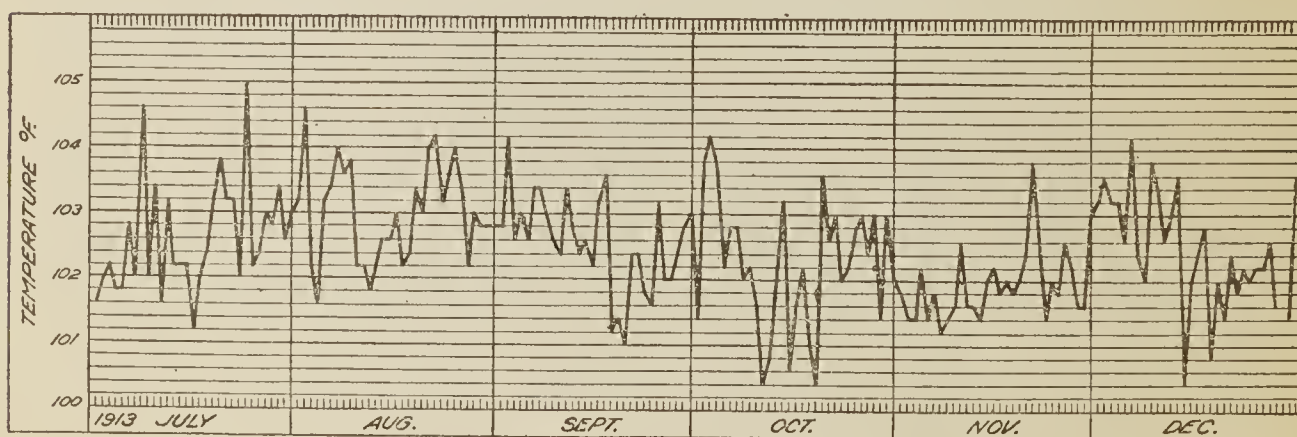


FIG. 5.—Temperature chart of Willowmoor Queen Bess.

paratively large number of native animals is planned for the near future as an indication of the extent of tubercular infection among



FIG. 1.—YEARLING FILLY BY CASSIUS, WITH DAM.



FIG. 2.—HALF-BLOOD AYRSHIRE BULL 18 MONTHS OLD; WEIGHT, 700 POUNDS.



FIG. 3.—HALF-BLOOD AYRSHIRE HEIFER 21 MONTHS OLD; WEIGHT, 600 POUNDS.



FIG. 1.—IMPORTED DOE, JAPANESE MILCH GOAT.



FIG. 2.—CROSSBRED BUCK, JAPANESE-NATIVE STOCK.



FIG. 1.—CROSSBRED DOE, JAPANESE-NATIVE.



FIG. 2.—PURE-BRED DOE, NATIVE.



the island stock, practically no information on this subject being now available. As a method of gaining general information concerning diseases among stock, and especially among the cattle of the island, it is planned to visit the island slaughterhouse from time to time, as the work of the station will permit, for the purposes of meat inspec-

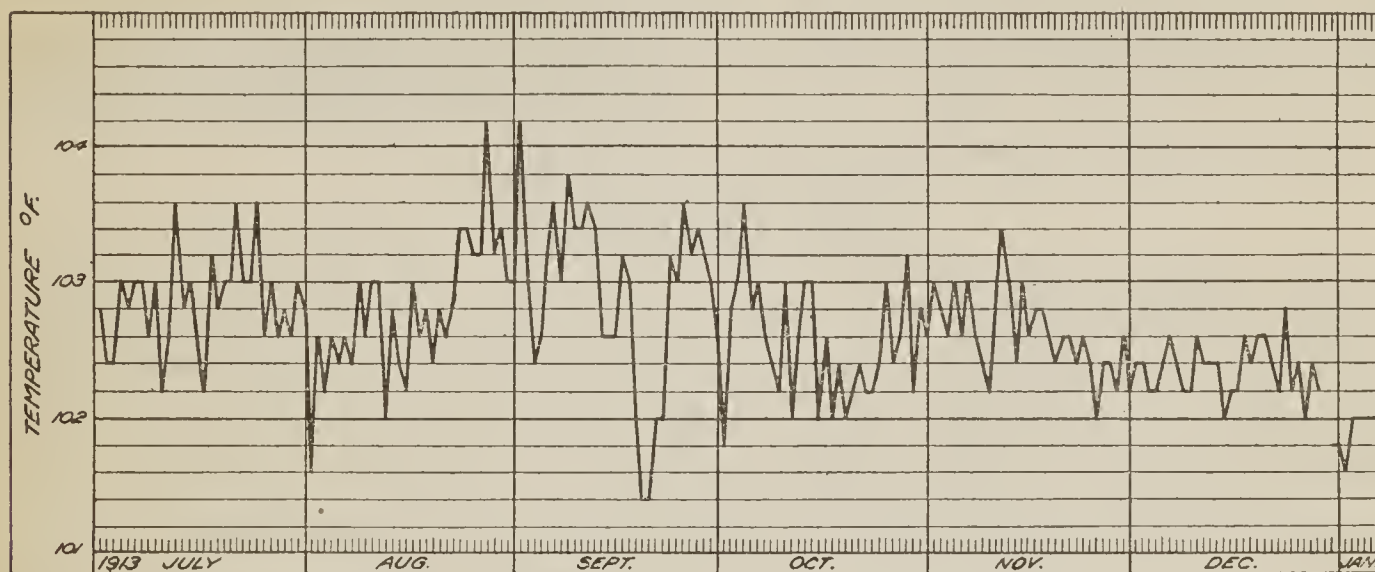


FIG. 6.—Temperature chart of Netherhall King B.

tion and to examine the carcasses of slaughtered animals. At the close of the year the station herd contained 20 native or grade cows, including heifers old enough for breeding purposes. Ten of this number were purchased near the close of the fiscal year, and most of these are well above the average native cow in size and conformation.

HOG BREEDING.

The work in hog breeding continues to be the most interesting and the most encouraging line of animal breeding. The rapid increase in this class of stock renders possible the distribution of half-blood boars to the various localities of the island, and this line of work is producing a noticeable improvement in the general class of hogs on the island. Six grade boars and seven grade sows have been sold during the year to parties who desired them for breeding purposes. The services of the station boars have been offered to the public free of charge as a continuation of the previous policy of the station. Six sows have been bred to No. 37, the three-quarter grade Berkshire boar, and 15 sows have been served by No. 36, the half-blood boar which was obtained by the station during the preceding annual period. The imported Berkshire sow, No. 14, failed to breed until November 21, 1913, when she was bred to No. 37. As a result of this breeding the sow delivered just one dead pig at farrowing time on May 22, 1914. The failure to raise a litter from this breeding was specially regretted, as the sow is unrelated to any of the present Berkshire strain, and the need of new blood in the herd is already becoming keenly felt. The experience has, however, demonstrated the possibility of breeding this sow, and this knowledge

is in itself encouraging. The sow was returned in service to station boar No. 36 before the close of the year. As the fiscal year drew toward an end, No. 39, a three-quarter blood Berkshire sow, was pregnant by a boar of similar breeding. The station now owns five half-blood brood sows, two three-quarter, and one pure-bred brood sow, and one half-blood boar, the three-quarter bred boar having died near the close of the year. As a whole, the herd has continued in good health and vigor, and the results of disseminating the blood of the Berkshire breeds is most encouraging.

GOAT BREEDING.

Goats of an inferior and degenerate type, which were probably introduced from Mexico during the Spanish reign in the Marianas, are now bred on the island more for the purpose of supplying pets for children than for direct utility. The doe of this strain is a most indifferent milch animal and is rarely used for dairy purposes. Goats are, however, occasionally milked to furnish a supply of fresh milk in cases of illness, and at these times the practice is continued only for a short time. During the year 1911 ex-Gov. Salisbury introduced from Japan, for the purpose of stocking Cabras Island, a doe and a buck spoken of as Japanese milch goats. The buck resembled in type the buck of the Toggenburg breed, being brown in color on the legs below the knees and hocks, and having a bar on either side of the face of a light-gray color. The doe bears a resemblance to the Saanen doe. Her color is pure white, and a strip of long hair extends along the spinal column. The buck died a few months after his importation, and at the present time the introduced doe is the only living survivor of this strain that is not contaminated with native blood. The cross between the milk type and the native strain is occasionally seen, and the superiority of this cross over the native animal is well marked. The illustration (Pl. IV, fig. 1) shows the imported doe of the Japanese milch type as she appeared during the past year. Within the last half of the fiscal year just ended the station has obtained possession of a small herd of goats, some of which are part blood descendants of the Japanese milch goats discussed above. A cross-bred buck (Pl. IV, fig. 2) of unusual size and good conformation and of a pure-white color has been obtained for breeding purposes. A half-blood doe belonging to the station is shown in Plate V, figure 1. Animals of this breeding are distinctly larger as well as much better milk producers than the native doe. Goats are reasonably hardy and free from disease in Guam, and a number of conditions exist which would indicate the adaptability of the milch goat, both in relation to the country and to the people. The goat is quickly and easily raised, a fact that means a low cost of production and a comparatively cheap animal to a poor class of

people. In comparison with the cow it is better able to withstand mistreatment and neglect to which animals in the hands of the native stockman are often exposed. There are relatively large areas of land on the island that are covered with dense thickets of underbrush or heavily wooded timber, now practically unutilized, that would be admirably suited for goat pasture. Much of the rock-covered hill lands which are of little value for other purposes could also be utilized as range for this class of animals.

CHICKEN RAISING.

The station flock of Plymouth Rock and Brown Leghorn breeds of chickens shows a tendency toward loss of vigor thought to result from inbreeding, which, through the lack of transportation facilities for the importation of new stock, has been unavoidable. More than 100 cockerels were sold for breeding purposes within the year, and an effort was made to place these birds in such localities as to insure their maximum breeding value. Hens obtained from crossing either of the introduced breeds on the native fowl are reported to be better layers than the latter and with the hardiness of that parent not greatly reduced. A number of breeding experiments have been begun during the year. In this work we have reared chicks of the pure Plymouth Rock breed, the pure Brown Leghorn breed, crosses of both these breeds with the native fowl, and chicks of the purely native type. The total number of chicks hatched was 1,180. The work in general has shown the unusual hardiness of the native chick as compared with those of either of the introduced breeds. The crossbred chicks, while probably not fully equal to those of the purely native strain, show greatly increased hardiness over those of pure Plymouth Rock or Brown Leghorn breeding. The object of the crossbreeding work is to secure a type of fowl having the advantages of greater hardiness than has been indicated in the work with the introduced breeds, with an increased size, if possible, and better egg-laying properties than has the native hen. The work has not progressed to a point where definite results can be reported.

Comparative experiments with Brown Leghorn chickens, ordinary natives, native black-meat fowls, and a cross between the latter and the Brown Leghorn have been conducted with the purpose of determining the relative susceptibility of the various breeds and strains to chicken pox. The results lead to the conclusion that chickens of these various strains are equally susceptible when of like age and vigor, other conditions being uniform.

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